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(19)(CA) APPLICATION FOR CANADIAN PATENT (12)

(54) Reactor for Drying Water-Containing Solids in a Heated Fluidized Bed and Method of Operating the Reactor

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Reactor for Drying Water-containing Solids in a Heated Fluidized Bed and Method of Operating the Reactor

DESCRIPTION

This invention relates to a reactor for drying water-containing solids in a heated fluidized bed, which reactor comprises above the fluidized bed a vapor-collecting space provided with a vapor outlet and, above the vapor-collecting space, means for feeding the water-containing solids, and relates also to a method of operating the reactor.

Reactor of that kind are known and have been described, e.g., in German Patent 29 01 723 and the corresponding U.S. Patent 4,295,281 and in German Patent 36 44 806 and DE-A-39 43 366. Said publications do not contain a discussion about how the water-containing solids, which preferentially form lumps as they are delivered, can be fed to the fluidized bed uniformly and in the finest possible state of division. U.S. Patent 2,412,057 discloses a rotating disk for laterally throwing material to be dried in a lateral direction from a supply passage by centrifugal force.

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C10B 57/10

It is an object of the invention so to design the reactor described first hereinbefore that the water-containing solids are distributed in the vapor-collecting space

in such a manner that any relatively large lumps will be destroyed. At the same time, the solids should be distributed as uniformly as possible over the top surface of the fluidized bed. This is accomplished in accordance with the invention in that an approximately conical distributor surface, which is rotatable about a vertical axis, is provided in the vapor-collecting space below the feeding means and slopes at an angle from 25 to 70° from the horizontal and has at least one aperture, which occupies 30 to 90% of the theoretical overall area of the distributor surface.

The approximately conical distributor surface is not a closed surface but has one or more apertures, through which part of the solids passes which come from the distributor surface. Said solids which fall through the aperture or apertures are moved radially outwardly by the rotating distributor surface to a much smaller extent so that the central portion of the fluidized bed under the distributor surface can fairly uniformly be supplied with solids just as the outer portions. Nevertheless the distributor surface also constitutes a baffle, by which particularly relatively large agglomerates formed by the solids falling from above are crushed.

The vapor-collecting space usually has a water vapor saturation of at least 80% and often of about 100%. Above the distributor surface that water vapor contacts the cold water-containing solids and condenses on the surface

thereof. This will promote the formation of agglomerates; that formation is opposed by the rotating distributor surface. By a choice of a suitable rotational speed of the distributor surface it is possible to adapt the action of that surface to the objects to be accomplished in dependence on solids of a given kind. In most cases the speeds lie in the range from 20 to 250 revolutions per minute.

The granular solids to be dried may consist, e.g., of coal, brown coal, ores or sludges of various kinds.

The largest diameter of the distributor surface is preferably 0.1 to 0.4 times the diameter of the top surface of the fluidized bed. To improve the function of the distributor surface, namely, to spread the solids as uniformly as possible over the fluidized bed and, at the same time, to intensify the crushing of the lumps, the top surface of the distributor surface member may be provided with projections, which may consist, e.g., of humps, teeth or ribs.

Optional further features of the reactor and details of its operation will be explained wtih reference to the drawing, in which

Figure 1 is a schematic longitudinal sectional view showing the reactor,

Figure 2 is a sectional view taken on line A-A in Figure 1 and showing the supply chamber,

Figure 3 is a perspective view showing a first embodiment of the distributor surface,

Figure 4 is a top plan view showing the distributor surface of Figure 4 viewed in the direction of the arrow B, and

Figure 5 is a top plan view showing a further embodiment of the distributor surface.

The reactor 1 is used to dry water-containing solids in a fluidized bed 2, which is indirectly heated by heat exchanger means 3. Superheated steam is preferably used as a fluidizing fluid and is supplied through line 4 and conducted into the fluidized bed 2 through a grate 5, which is constituted, e.g., by horizontal tubes and formed with orifices. The water vapor formed as a result of the drying is collected together with the fluidizing fluid in the vapor-collecting space 6 over the fluidized bed 2. The atmosphere which is rich in water vapor is withdrawn through the vapor outlet 9. Substantially dry solids are taken through a metering lock chamber 10 from the lower end of the reactor 1.

The solids to be dried are supplied through an inlet lock chamber 11 into a supply chamber 12, which in its bottom 13 has an outlet opening 14; see also Figure 2. A crescent-shaped pusher 16 is moved over the bottom 13 in the direction indicated by the arrows 15 to push the solids to the outlet 14. Spaced above the outlet 14 is a rigid conical shield 17; see Figure 1, which prevents solids from the

supply chamber 12 to fall down freely through the outlet 14. An approximately conical distributor surface 19 is secured to the bottom end of a vertical shaft 18, which extends through the outlet 14. In a manner known per se, not shown, the distributor surface 19 can be driven at a controllable speed about a vertical axis by means of the shaft 18, which extends to the outside. The rotational movement of the distributor surface 19 is independent of the motion of the crescent-shaped pusher 16, with which separate drive means, not known, are associated.

In order to prevent a disturbing rise of vapors rich in water vapor from the vapor-collecting space 8 through the outlet 14 into the supply chamber 12, air or nitrogen, for instance, may be supplied thorugh line 20 in order to maintain in the chamber 12 a pressure which is approximately as high as the pressure in the vapor-collecting space 8.

The water-containing solids which have been moved to the outlet 14 by the crescent-shaped pusher 16 fall down and impinge on the rotating distributor surface 19. As a result, agglomerates formed by the solids are crushed. The distributor surface 19 is so shaped that the solids are distributed as uniformly as possible over the top surface of the fluidized bed 2.

A possible form of the distributor surface 19 is shown in Figures 3 and 4. Figure 3 is a perspective view and Figure 4 a top plan view taken in the direction indicated

by the arrow B in Figure 3. The conical distributor surface 19 has two apertures 20a and 20b so that the surface 19 is partly apertured. In practice, the shape of said apertures may be varied in a wide range or the distributor surface may have only one aperture or several apertures. Without such apertures the largest diameter of the distributor surface 19 would describe a circle, see Figure 4, where that circle is indicated by broken lines adjacent to the apertures 20a and 20b. The resulting closed circle defines the theoretical overall area of the distributor surface. In that theoretical overall area the apertures are not taken into account. The area of the apertures is 30 to 90% of the theoretical overall area of the distributor surface 19. The area and shape of the apertures 20a and 20b may be chosen within a wide range so that the design of the distributor surface can be adapted to different functions. The largest diameter D of the distributor surface 19, see Figure 4, is usually 0.1 to 0.4 time the diameter of the top surface of the fluidized bed 2.

Figure 5 shows a somewhat different embodiment of the distributor surface 19a, which is preferably rotated in the direction indicated by the arrow 22 about the vertical shaft 18. The apertures 23a and 23b are defined on the outside by the broken circular line, which defines the largest diameter. For that distributor surface 19a it is also shown that

the top surface of the distributor surface member may be provided, e.g., with humps 23 or ribs 24 in order to intensify the crushing of lumps of solids as the surface 19a is rotated and to influence the course of the solids. Such projections can be used to improve the uniform distribution of the solids on the fluidized bed 2.

CLAIMS

1. A reactor for drying water-containing solids in a heated fluidized bed, which reactor comprises above the fluidized bed a vapor-collecting space provided with a vapor outlet and, above the vapor-collecting space, means for feeding the water-containing solids, characterized in that an approximately conical distributor surface, which is rotatable about a vertical axis, is provided in the vapor-collecting space below the feeding means and slopes at an angle from 25 to 70° from the horizontal and has at least one aperture, which occupies 30 to 90% of the theoretical overall area of the distributor surface.

2. A reactor according to claim 1, characterized in that the largest diameter of the distributor surface is 0.1 to 0.4 time the diameter of the top surface of the fluidized bed.

3. A reactor according to claim 1 or 2, characterized in that projections are provided on the top surface of the distributor surface member.

4. A method of operating a reactor for drying water-containing solids in a heated fluidized bed, which reactor comprises above the fluidized bed a vapor-collecting space provided with a vapor outlet and, above the vapor-collecting space, means for feeding the water-containing solids, wherein an approximately conical distributor surface, which

is rotatable about a vertical axis, is provided in the vapor-collecting space below the feeding means and slopes at an angle from 25 to 70° from the horizontal and has at least one aperture, which occupies 30 to 90% of the theoretical overall area of the distributor surface, characterized in that the distributor surface is rotated at a speed of 20 to 250 revolutions per minute.

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Fig.1

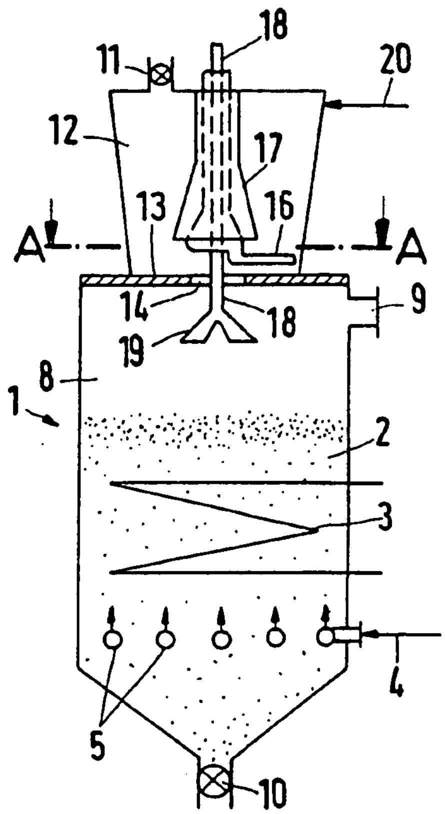

Fig.3

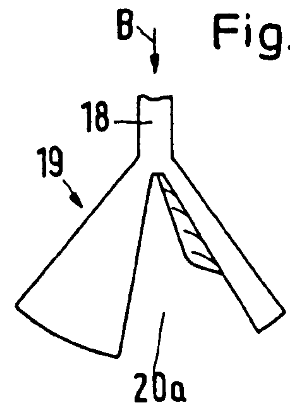

Fig.4

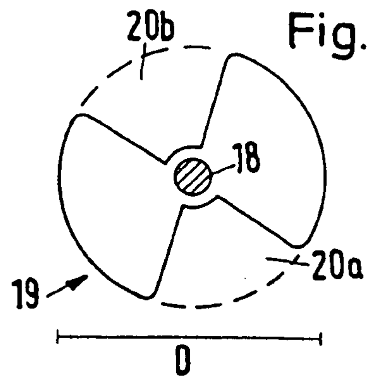

Fig.2

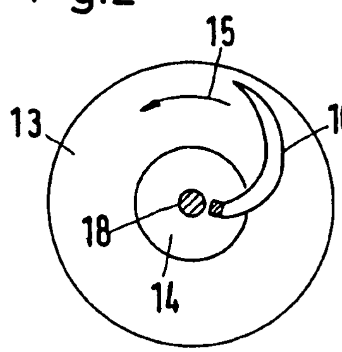

Fig.5